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(54) **Testing liquid/liquid interaction**

(57) The invention provides apparatus for testing of liquid/liquid interaction at an elevated temperature comprising a furnace, means fixedly mounted within the furnace for holding the liquids, and electromagnetic field induction means located around the liquids when located within the furnace and arranged for electrical connection such as to create a magnetic field rotating generally about a vertical axis passing through the liquids.

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FIG. 1.

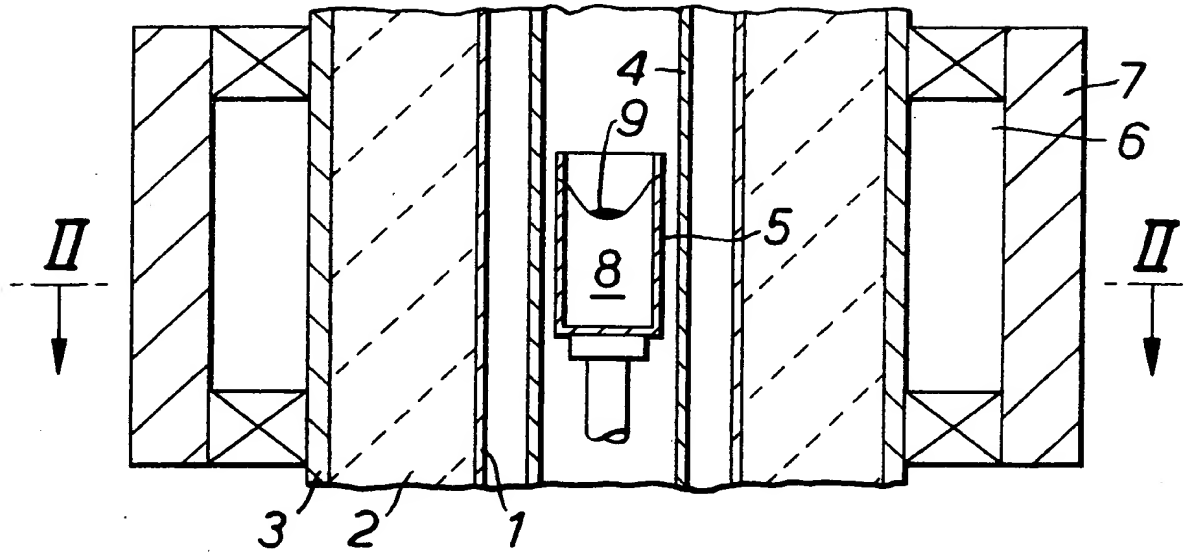
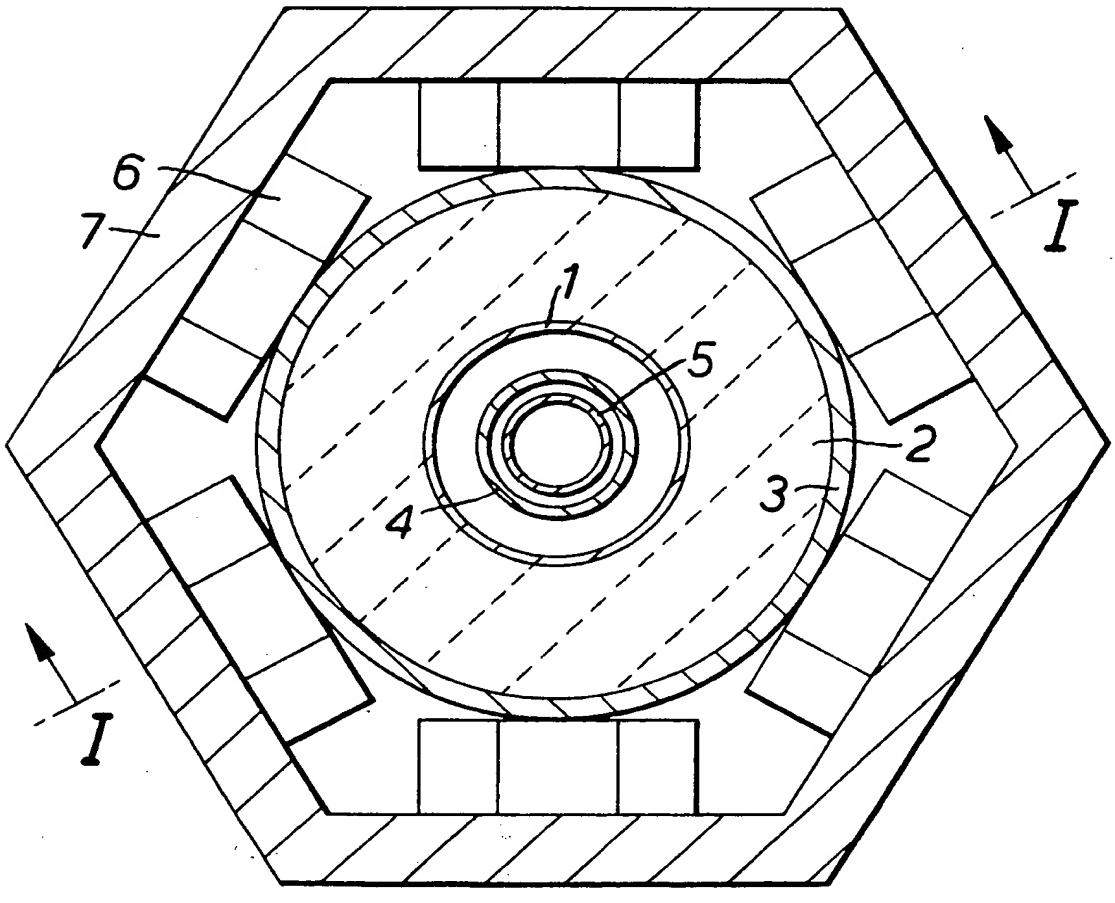


FIG. 2.



SPECIFICATION

Testing liquid/liquid interaction

This invention relates to improvements in apparatus for testing of liquid/liquid interaction wherein one of the materials is electrically conductive, and more particularly, but not exclusively for testing slag/metal interaction for metallurgical processes.

In metal, particularly steel, refining processes it is necessary to know the dynamic relationship between the molten metal contained in a metallurgical vessel and its overlying slag. Thus with sophisticated modern refining processes it is essential to be aware of the equilibrium relationships for complex slag systems; to evaluate the effects and performance of slags used; and to establish the fundamental thermodynamics of proposed new slag formulations before plant trials.

Commonly this is done by means of laboratory scale apparatus comprising a refractory crucible containing the liquid metal which is equilibrated with the appropriate and corresponding slag at closely controlled temperatures up to about 1700°C. In view of the highly corrosive nature of such slags it is usually extremely desirable to avoid contact of the slag with the containing refractory crucible.

Proposals have previously been made for avoiding contact between the slag and the refractory crucible. Thus, for example, it has been suggested to mount the crucible for rotation within a resistance heating furnace, the basis of this proposal being that rotation of the crucible will rotate its contents, but due to the different densities of the slag and metal, there will be a tendency for the metal to ride up the internal wall of the crucible thereby providing a separation between the slag and the crucible wall.

However it has been found that this arrangement suffers from a number of disadvantages. Thus, for example, if the slag contact angle with the metal is small (such as would be the case with a slag containing e.g. calcium fluoride) the slag will tend to creep across the liquid metal surface and contact and wet the refractory crucible.

It is an object of the present invention to provide apparatus for testing liquid/liquid interaction, such as the slag/metal interaction in metallurgical processes, of a simple and convenient nature which overcomes the above-mentioned problem.

According to the invention there is provided apparatus for testing of liquid/liquid interaction at an elevated temperature comprising a furnace, a means fixedly mounted within the furnace for holding the liquids and electromagnetic field induction means located around the liquids when located within the furnace and arranged for electrical connection such as to create a magnetic field rotating generally about a vertical axis passing through the liquids. In many cases the means for holding the liquids within the furnace may conveniently comprise a crucible. This is particularly true when dealing with slag and liquid metal. The electromagnetic field induction means may be arranged to create a magnetic field rotating generally about the vertical axis of the crucible.

By means of the rotational field created within the crucible in use of the apparatus by means of the invention as hereinabove defined the molten metal in the crucible will be caused to respond to the electromagnetic field and rotate within the fixed crucible. However, the slag will not be affected by a similar rotating force and will therefore tend to rotate only to the extent caused by its frictional contact with the underlying liquid metal. The outer rim of the metal surface is held stationary at the wall and the surface velocities may be lower than those just under the surface. There is also some levitating force on the liquid metal. As a consequence whilst the metal will tend to ride up the walls of the crucible, the overlying slag will have a much lesser tendency so to do and will therefore be safely separated by a rim of molten metal from contact with the refractory crucible. Tests have shown that up to three times as much slag may, in some cases, be contained in the same size of vortex using magnetic rotation as compared to a mechanically rotated crucible.

In order that the invention may be more readily understood one embodiment thereof will now be described by way of example with reference to the accompanying drawing in which:—

Figure 1 is an elevational cross-section of part of apparatus in accordance with the invention; and

Figure 2 is a sectional plan on the line II—II of Figure 1.

Referring now to the drawings it will be seen that the apparatus comprises a resistance furnace including a winding tube 1 surrounded by an annular layer of insulation 2 and a casing 3.

Disposed within the furnace is a reaction tube 4 within which is located during testing operation a reaction crucible 5.

Surrounding the furnace case 3 is an assembly of electromagnetic coils 6 carried within a frame 7. The coils 6 are electrically connected so as to provide a rotational field about the axis of the crucible.

As can be seen from Figure 1 in operation of the furnace and with the coils 6 connected to provide the aforementioned rotating electromagnetic field, the metal 8 within the crucible is caused to rotate correspondingly and thereby rides up the side walls of the crucible. The slag 9, however, is retained centrally of the crucible and is clearly separated from the wall thereof by the metal 8. Testing can be carried out in the normal way by sampling and/or analysis of gas emission without risk of contact between the slag and crucible wall.

It is also possible to use other forms of heating such as induction or radiation to very high temperatures. Thus by using, say, plasma, solar, arc or laser heating a central portion of a block of

conducting material could be melted and a vortex formed in the molten material. It would then be possible to introduce a second phase into the vortex and to observe the chemical interaction. Thus the material could be any metal or conducting non metals such as alumina, urania, thoria, zirconia, or uranium carbide for example.

CLAIMS

1. Apparatus for testing liquid/liquid interaction at an elevated temperature comprising a furnace; a means fixedly mounted within the furnace for holding the liquids and electromagnetic field induction means located around the liquids when located within the furnace and arranged for electrical connection such as to create a magnetic field rotating generally about a vertical axis passing through the liquids.

2. Apparatus according to Claim 1 wherein the means for holding the liquids within the furnace comprises a crucible.

3. Apparatus according to Claim 2 wherein the electromagnetic field induction means is arranged to create a magnetic field rotating generally about the vertical axis of the crucible.

4. Apparatus according to Claim 1 wherein the means for holding the liquids within the furnace comprises a block of solid material, the central upper portion only of which is melted within the furnace to form one of said liquids.

5. Apparatus according to any one of Claims 1 to 4 wherein the furnace is resistance heated.

6. Apparatus according to any one of Claims 1 to 4 wherein the furnace is induction heated.

7. Apparatus according to any one of Claims 1 to 4 wherein the furnace is heated by radiation.

8. Apparatus for testing liquid/liquid interaction substantially as shown in and as hereinbefore described with reference to the accompanying drawing.

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